

Small Scale Vapor Mitigation

From Due Diligence to Post System Installation Operations and Maintenance Plans

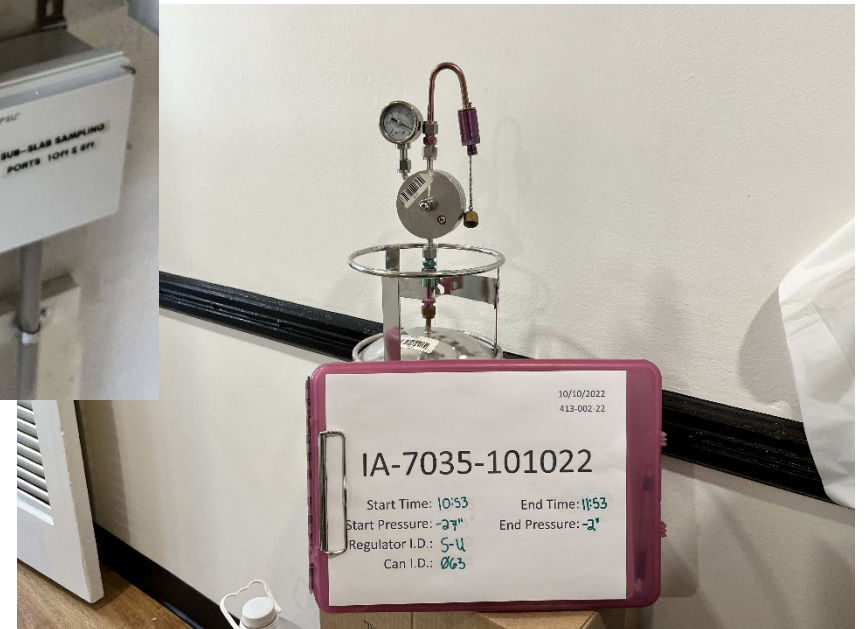
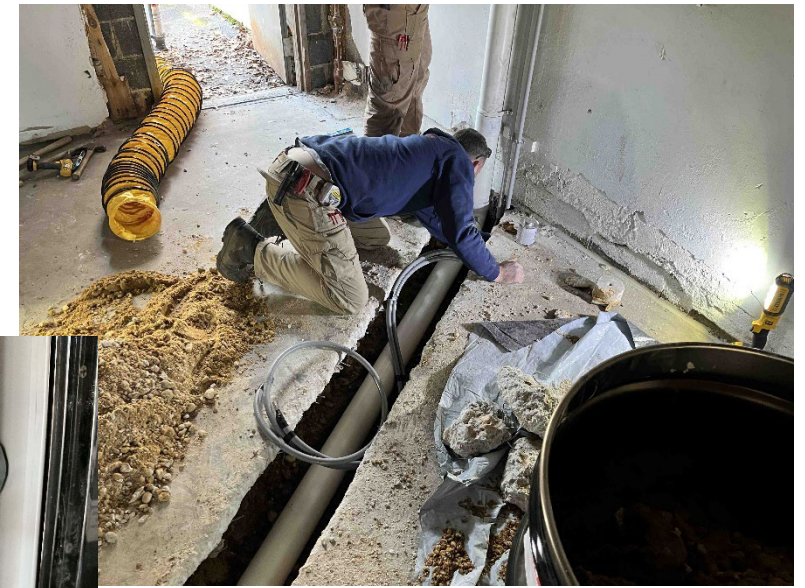
November 15, 2024

Prepared by:



Topics of Discussion

- Introduction
- Environmental Due Diligence
- Developing the Plan
- Diagnostics and System Design
- Post-System Sampling / Land Use Restrictions
- Long Term O&M
- Case Studies



THE URBAN GREEN TEAM

- Environmental Consulting Firm in Locust Point, Baltimore City
- Established in March 2007
- 8 employees
- Collaborative group of Engineers, Scientists and Geologists
- Key Employees:
 - Denise A. Sullivan, P.E., Principal
 - Gary Suskauer, Client Services Manager
 - David Sena, Director of Environmental Services



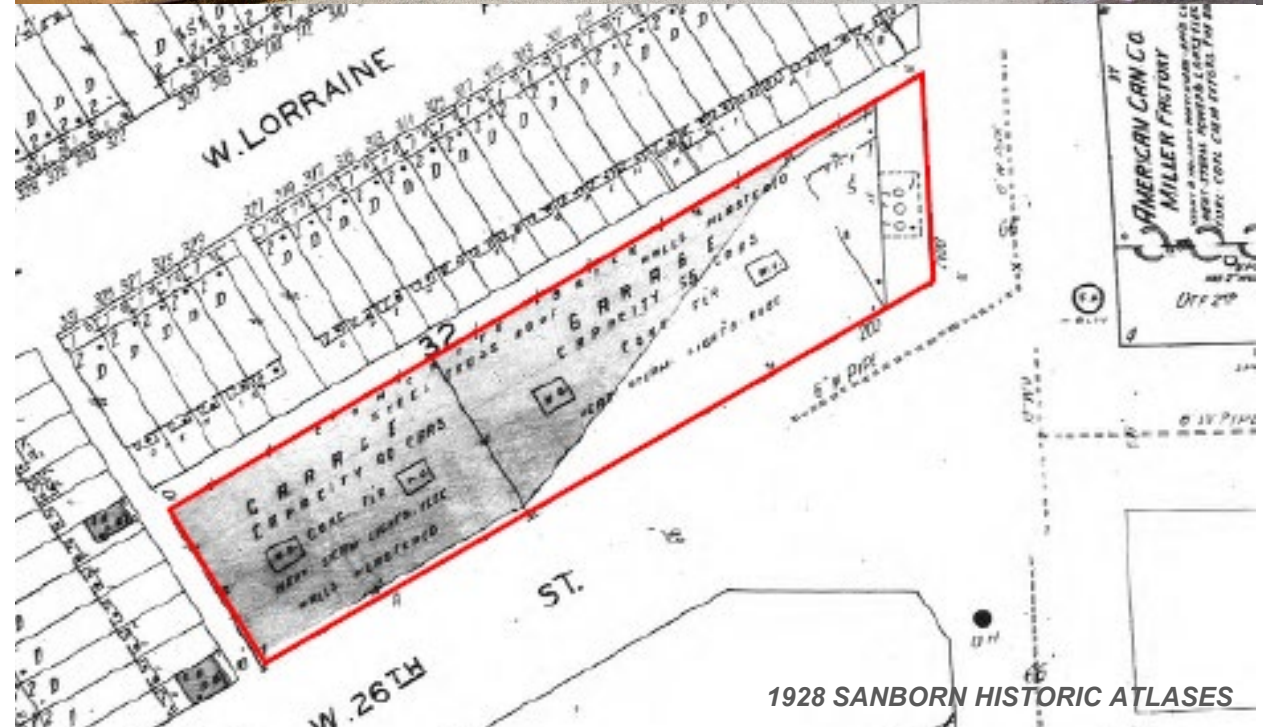
The Need for Vapor Mitigation Typically Results from Due Diligence

Why Perform Environmental Due Diligence?

- Reduce Risk (e.g. CERCLA liability)
- Identify Unknown Conditions
- Understand Property Limitations
- Understand Timing for Investigations/Closure
- Understand Costs
- Understand Red Flags for Future Financing / Development /
- Support Regulatory Programs (VCP/CHS)



Photography by Michael Temchine



Environmental Due Diligence

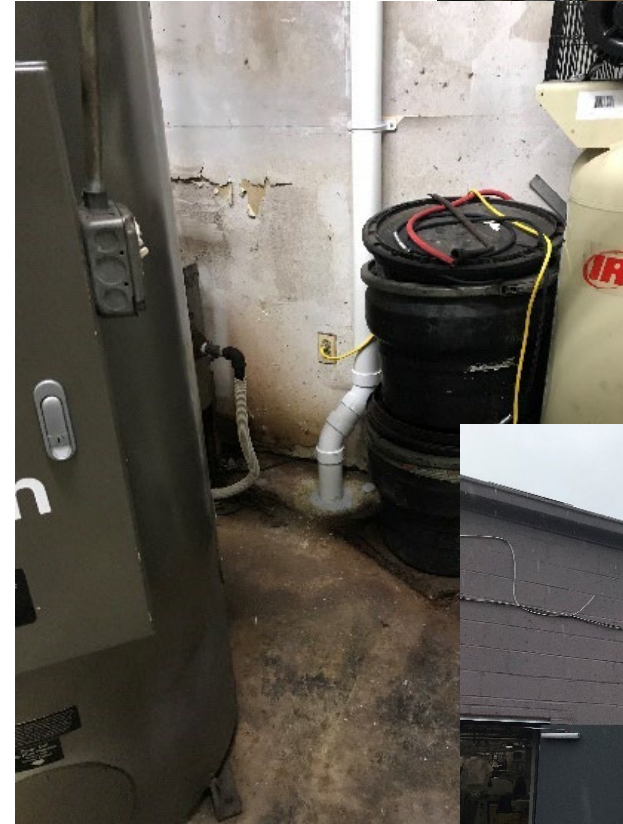
PHASE I ENVIRONMENTAL SITE ASSESSMENTS

Goal

To investigate a property by non-intrusive means and evaluate a release or potential release of hazardous materials and/or petroleum products to the environment.

Common Drivers for Vapor Intrusion Condition

- *Current/Former Dry Cleaner*
- *Current/Former Auto Repair*
- *Current or Former Tanks (underground or aboveground)*
- *Former Gasoline filling station*
- *Former Printers*
- *Former Manufacturing*
- *Adjoining and Nearby Properties*
- *Prior Environmental Reports*



PHASE I ENVIRONMENTAL SITE ASSESSMENT

A good Phase I can provide critical information for future investigations, development of the Conceptual Site Model, and vapor mitigation system design

EXAMPLE PHASE I ESA INFORMATION	
Property Overview	Current Utilities (Municipal Water and Sewer vs. Well/Septic) Foundation type (old vs. new, slab, crawl space, basement) Building configuration and Building expansion over time HVAC Tenants/current use(s) Inaccessible areas Access (future equipment) Preferential Pathways On-site and off-site Receptors
Historic Records	Solvent or Petroleum storage areas / uses
Regulatory Records	Chemical usage and generation (RCRA) Spills / Prior Case Files (MDE OCP, LRP, SHW) Tanks Nearby wells
Interviews	Uses (current, historic, future)
Figure	Building and Site Layout Chemical use areas Utility locations (if known) Neighboring properties / Right-of-ways
Photos	Current slab conditions Building configuration Access
Report User	Owner, Purchaser, Investor, Fiduciary, Tenant

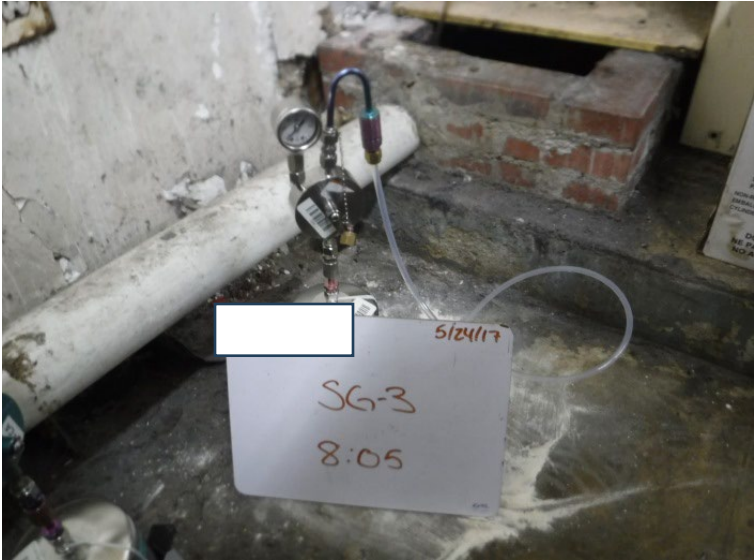
ONLINE (FREE) RESOURCES

Resource	Website	Information Available
Maryland Department of the Environment (MDE) LRP Map	https://mde.maryland.gov/programs/LAND/MarylandBrownfieldVCP/Pages/mapping.aspx	MDE VCP / CHS listings; link to Maryland Department of Assessment and Taxation (SDAT)
Maryland Department of Assessment and Taxation, Real Property Database	https://sdat.dat.maryland.gov/RealProperty/Pages/default.aspx	Property information Property Map (ex. Baltimore City)
Maryland Land Records	https://www.mdlandrec.net/main/	Current Deed; historical deeds
MDE Oil Control Program (OCP) UST Facility Summary Report	https://mes-mde.mde.state.md.us/FacilitySummary/default.aspx	MDE Underground Storage Tank Case Files
MDE OCP LUST Listings	https://mes-mde.mde.state.md.us/caseinformation/	MDE Oil Releases / UST Closures
United States Environmental Protection Agency (USEPA)	https://enviro.epa.gov/facts/myproperty/	Federal permits, listings and sites
County GIS / Mapping	County specific https://www.baltimorecountymd.gov/departments/information-technology/gis/	County GIS systems will often have zoning information, old site figures, etc.
Google Earth Pro	https://www.google.com/earth/about/versions/#earth-for-web	Historical Aerials; recommend download app – version has more data
NETR	https://netronline.com/public_records.htm	Regulatory databases and aerial
Enoch Pratt Library Online Sanborns	https://www.prattlibrary.org/research/databases/maryland-dc-sanborn-maps	Historical Sanborn Atlases

Environmental Due Diligence

PHASE II

ENVIRONMENTAL SITE ASSESSMENTS



PHASE II ENVIRONMENTAL SITE ASSESSMENT

*During the Phase II ESA
we start to understand
why we may need a
vapor mitigation
system*

<i>EXAMPLE PHASE II ESA INFORMATION</i>	
Phase II Planning	Current and Future Building Locations Property Survey Utility locations (MissUtility / Private Utility Markouts) Current / Former Tank Locations (Ground Penetrating Radar / Geophysical Investigations) Concrete / Slab condition Access Inaccessible Areas Discharge Locations Confirm Phase I ESA observations/results
Field Investigation	Concrete / Slab Thicknesses Subslab Soil Type Depth to Groundwater Presence of Perched Water Fill Access Field Observations (odor, color/staining) Field Screening (PID, CGI)
Sample Results	Soil Groundwater Soil Gas (active, passive, timed)
Current and Future Uses	Residential Non-residential/Commercial Recreational Redevelopment Program

Environmental Due Diligence

SUPPLEMENTAL PHASE II

ENVIRONMENTAL SITE ASSESSMENTS

- *Confirm initial results*
- *Further evaluate suspect source areas*
- *Delineation*
- *Confirm seasonality of results*
- *Provide additional site characterization*
- *New sampling to address redevelopment plan modifications*
- *Standard of Care*

Developing the Remediation Plan / Vapor Mitigation System



- Project Requirements
- Time / Cost / End Use
- Land Use Restrictions
- Conceptual Site Model
- Diagnostics
- Vapor Mitigation System
- Post System Confirmatory Sampling
- Final Reporting
- Environmental Covenant
- Operations and Maintenance Plan



Legend

- Property boundary
- Building footprint
- Dry Cleaning Unit
- Pad-Mounted Transformer
- Below grade Electric
- Below Grade Natural Gas
- Below Grade Water
- Unknown below grade utility
- Interior Building Partition
- Prior Soil Boring/ Temporary Well Location
- Prior Soil Boring/Soil Gas Point
- Prior Soil Gas/Indoor Air Sample
- Soil Gas Sample Locations
- Ambient Air Sample Location
- SSDS System Location

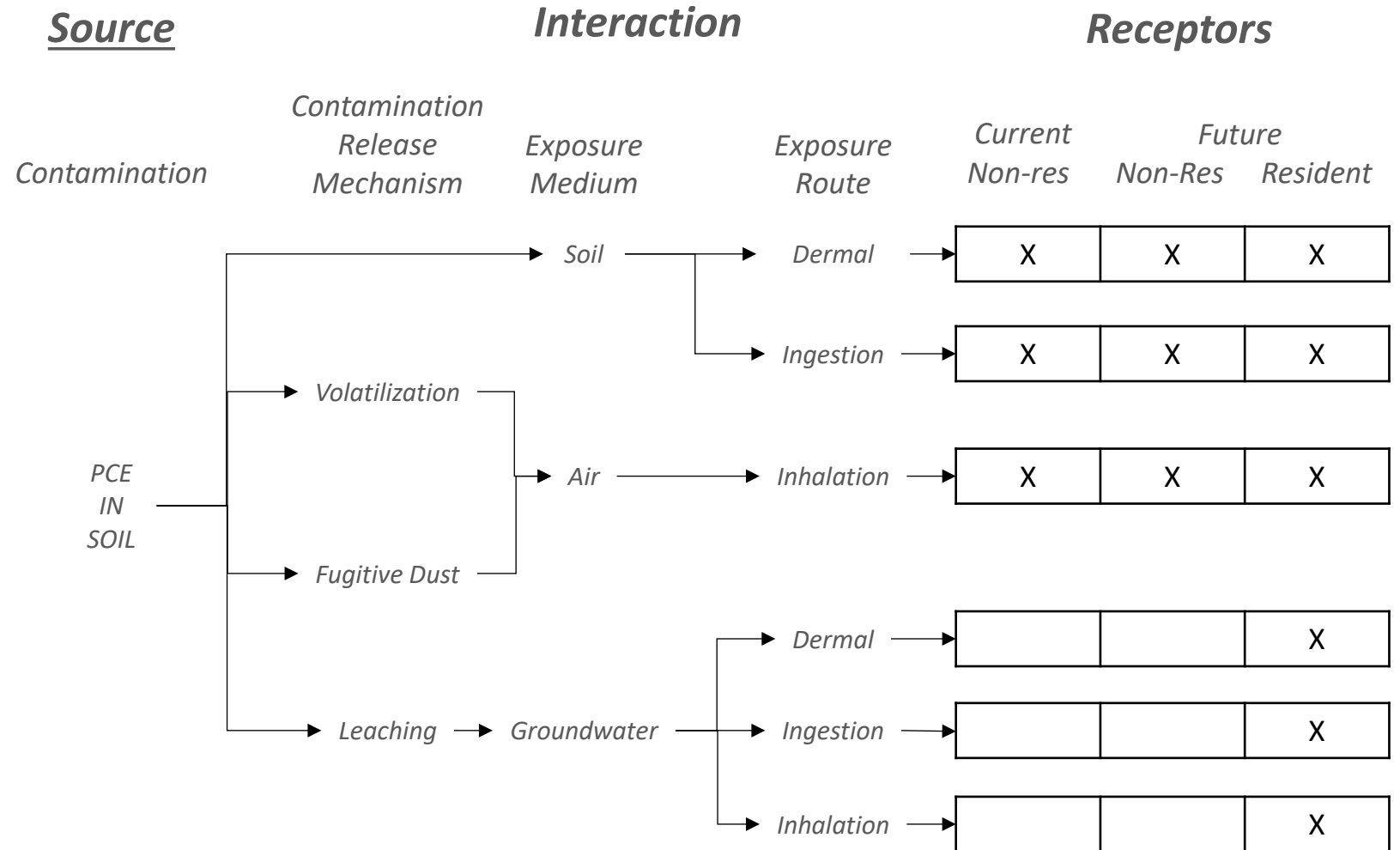
Utility locations are based on 2017 and 2018 utility surveys performed during the prior Phase II investigations by Master Locators. Sanitary sewer was unable to be confirmed however, based on cleanout locations, it runs along the southern side and beneath the building foundation to three cleanout locations northwest of the building footprint.

CONCEPTUAL SITE MODEL

Conceptual Site Model

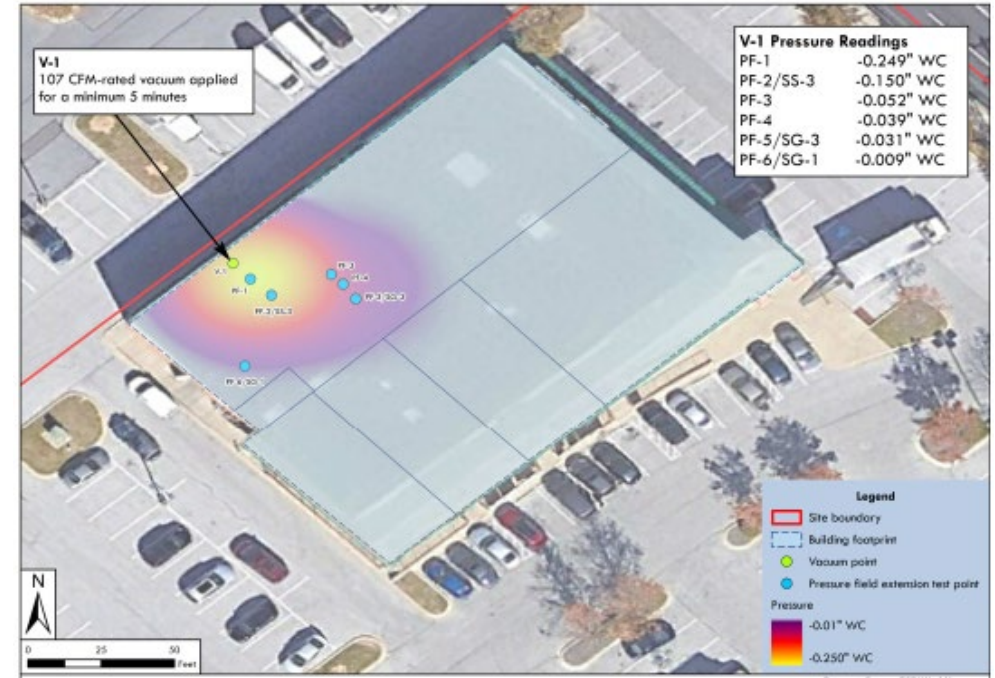
Summarizes site information and identifies the relationship between exposure pathways (complete, incomplete, anticipated) and potential receptors

This is an iterative process and is updated as data gaps are identified and filled!



Example Conceptual Site Model

Diagnostics



Vapor Mitigation System Design

Post System Confirmatory Sampling

- *Permanent Vapor Monitoring Points*
- *Indoor Air*
- *Effluent / Stack Sampling*
- *Sample Frequency*
 - *30 day or 60 day*
 - *180 day*
 - *12 month*

Future Use Restrictions and Institutional Controls

- *Land Use Restrictions (Tier I, II, III, IV)*
- *Groundwater Use Restriction*
- *Environmental Covenant*
- *Operation and maintenance plan*
- *Notice to MDE for any future soil excavation or disturbance*
- *Plan for handling groundwater encountered during excavations*
- *Vapor mitigation system operations and maintenance plan*
- *Installation of a vapor mitigation system for any future Site buildings*
- *Prohibition from single family residential*

Operation and Maintenance Plans

Monthly Checklist (facility personnel)

DATE	Power Indicator On	Fan Warning Light Activated	Pressure Gauge Reading	Blower Fan Operational (Y/N)	Discharge Piping Clear of Obstructions (Y/N)	Air Intakes within 25 ft (Y/N)	Failure Alarm Activated (Y/N)	Maintenance or Shutdown since last inspection (Y/N)	Response Required or Comments
July 19, 2023 / Example	Y	N	0.01 in	Y	Y	N	N	N	Fans operational, no shutdowns or alarms since last inspection.
January __, 2024									
February __, 2024									
March __, 2024									
April __, 2024									
May __, 2024									
June __, 2024									
July __, 2024									
August __, 2024									
September __, 2024									
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November __, 2025									
December __, 2025									

Annual Inspection

YEARLY SUB-SLAB DEPRESSURIZATION SYSTEM INSPECTION FORM

Sub-Slab Depressurization System Inspection Form		SITE LOCATION / ADDRESS
Date:	Time:	
Yearly: All aspects of the system shall be visually inspected including the exhaust fan, failure alarm and discharge piping on the rear building exterior.		
YEARLY GENERAL CONDITION OF BLOWER SYSTEM	<input type="checkbox"/> Fan Operational <input type="checkbox"/> Discharge piping clear of obstructions <input type="checkbox"/> No air intakes within 25 feet	<input type="checkbox"/> Fan Not Operational <input type="checkbox"/> Discharge piping obstructions <input type="checkbox"/> Air intakes present within 25 feet
	Comments or Corrective Actions <u>Required</u> :	
YEARLY FAILURE ALARM ACTIVATED SINCE PRIOR INSPECTION	<input type="checkbox"/> Yes <input type="checkbox"/> No Comments: _____	
YEARLY EXHAUST SYSTEM MAINTENANCE OR SHUTDOWN SINCE PRIOR INSPECTION	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Planned Comments: _____	
RESPONSE REQUIRED		
WORK COMPLETED		
RESPONSE CONTRACTOR	Work Completed By: _____ Date: _____ Signature: _____	

Photographs – System Elements



Photograph 1. PRIMARY SYSTEM Exterior View – Vapor Mitigation System Exhaust Piping
Vent should be free and clear of obstructions



Photograph 2. PRIMARY SYSTEM – Fan and Connections
Fan should be running, there should be no loose connections and black bolt or lock which prevents shut off should be present



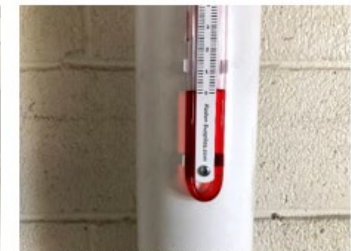
Photograph 3. PRIMARY SYSTEM – Vapor Mitigation System Gauge
Gauge should show a pressure difference between subsurface and outside air (as shown)



Photograph 4. SECONDARY SYSTEM Exterior View – Vapor Mitigation System Exhaust Piping
Vent should be free and clear of obstructions



Photograph 5. SECONDARY SYSTEM – Fan
Fan should be running, with minimal noise there should be no loose connections



Photograph 6. SECONDARY SYSTEM Interior View – Vapor Mitigation System Gauge
Gauge should show a pressure difference between subsurface and outside air (as shown)

Case Study – Active Strip Shopping Center / Vacant Unit

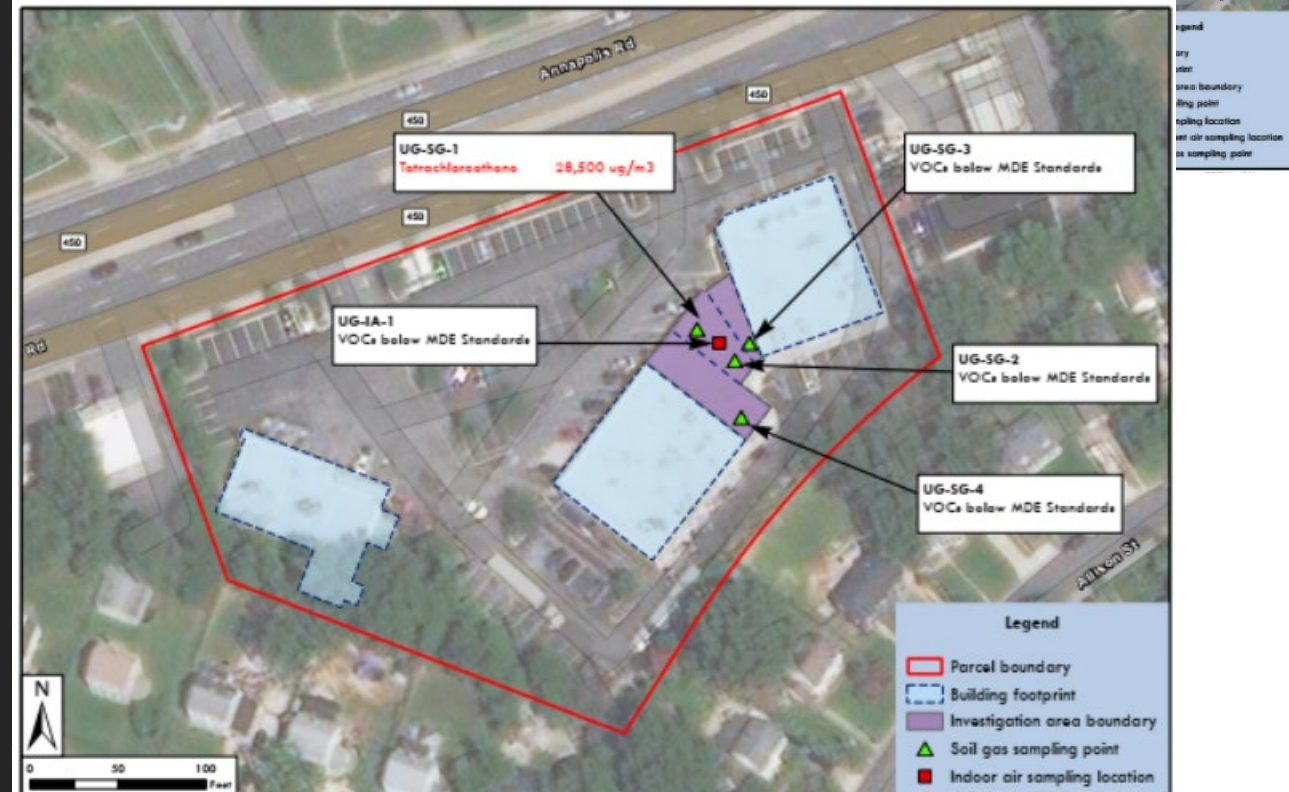
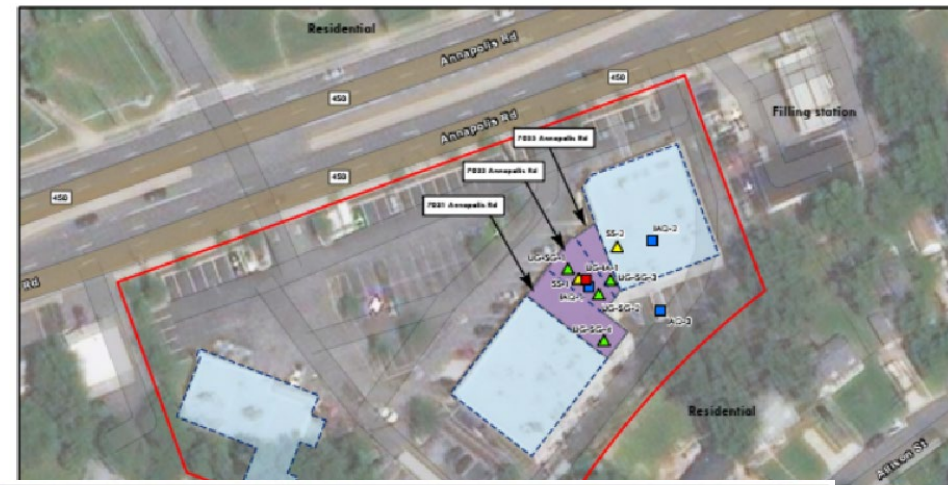


Initial Actions

- Seal floor cracks
- Soil Gas Sampling
- Indoor Air Sampling

Results

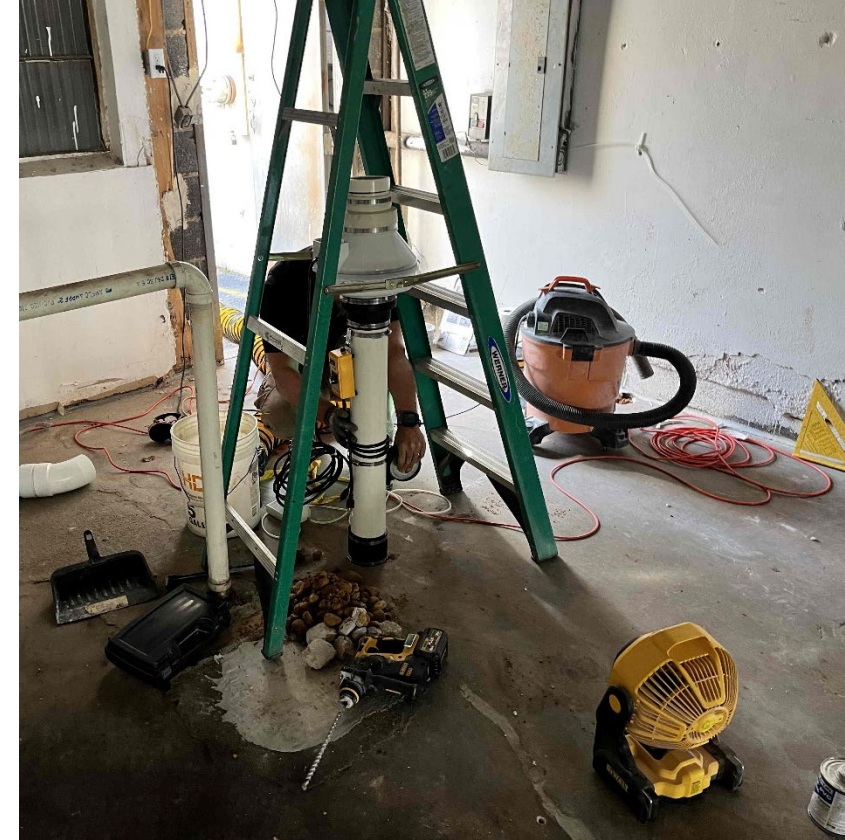
- Impacts confirmed in soil gas
- Indoor Air – 13,300 ug/m³ to 58.8 ug/m³





SUPPLEMENTAL INVESTIGATION

- Private Utility Markout
- Soil Gas Sampling
- Indoor Air Sampling



SSDS DIAGNOSTICS

- Four sub slab air pressure test holes
- Two suction points
- Pressure field analysis (variable fan)
- 59 CFM at 2.4 in. WC calculated for mitigation

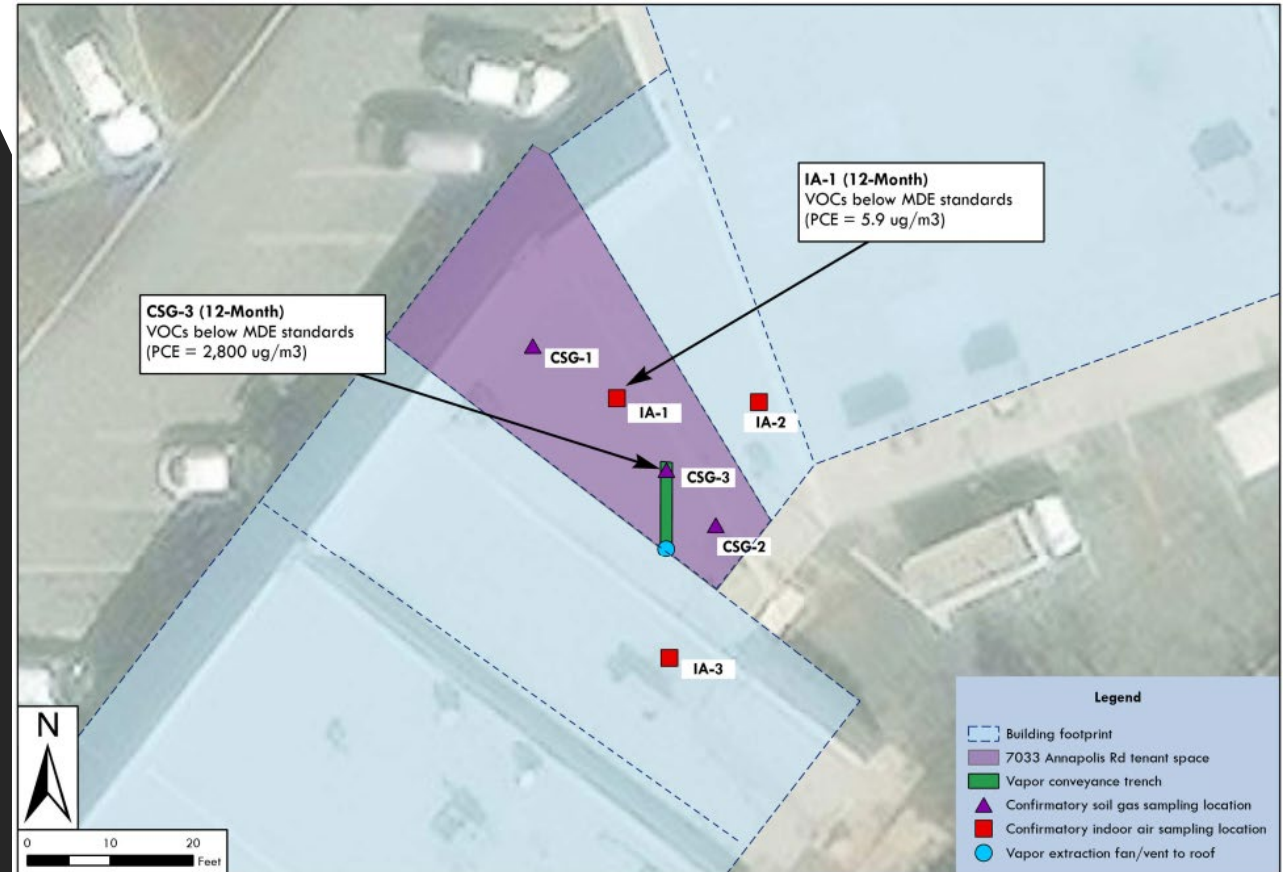
Vapor Mitigation System Design

- Active venting system
 - 10 ft trench, 1 ft wide, 1 ft deep
 - 4 inch pvc piping
 - FanTech RN4-E
 - Pressure Gauge/Alarms
 - Permanent VMPs
 - Waste Disposal
- Post System Installation Pressure Field Testing
- Confirmatory Sampling
 - Effluent Sampling
 - Soil Gas Sampling
 - 60-day
 - 180-day
 - 12-month



PROJECT SUMMARY

- Total Cost \$38,500
- Project Timeframe 09/2022 to 2/2024
- Remaining Actions 2 year post system sampling





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ENVIRONMENTAL

Case Study

Former Dry Cleaner(s) and Gas
Station

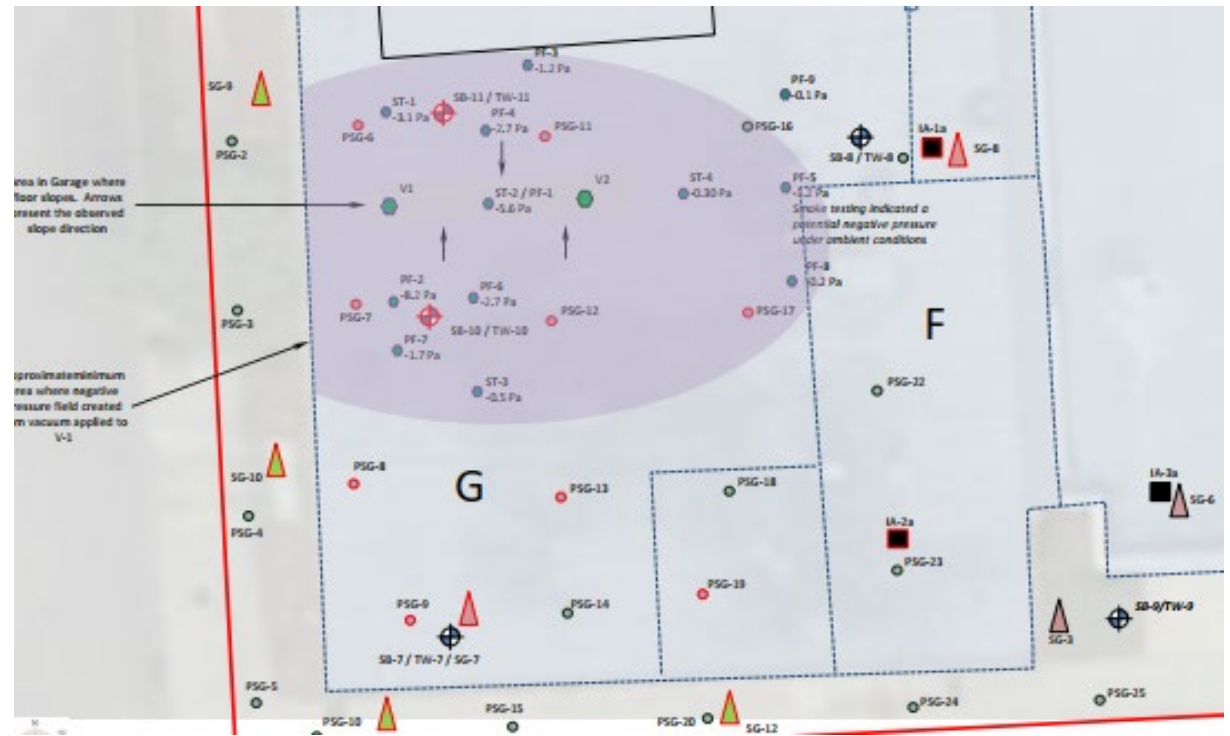
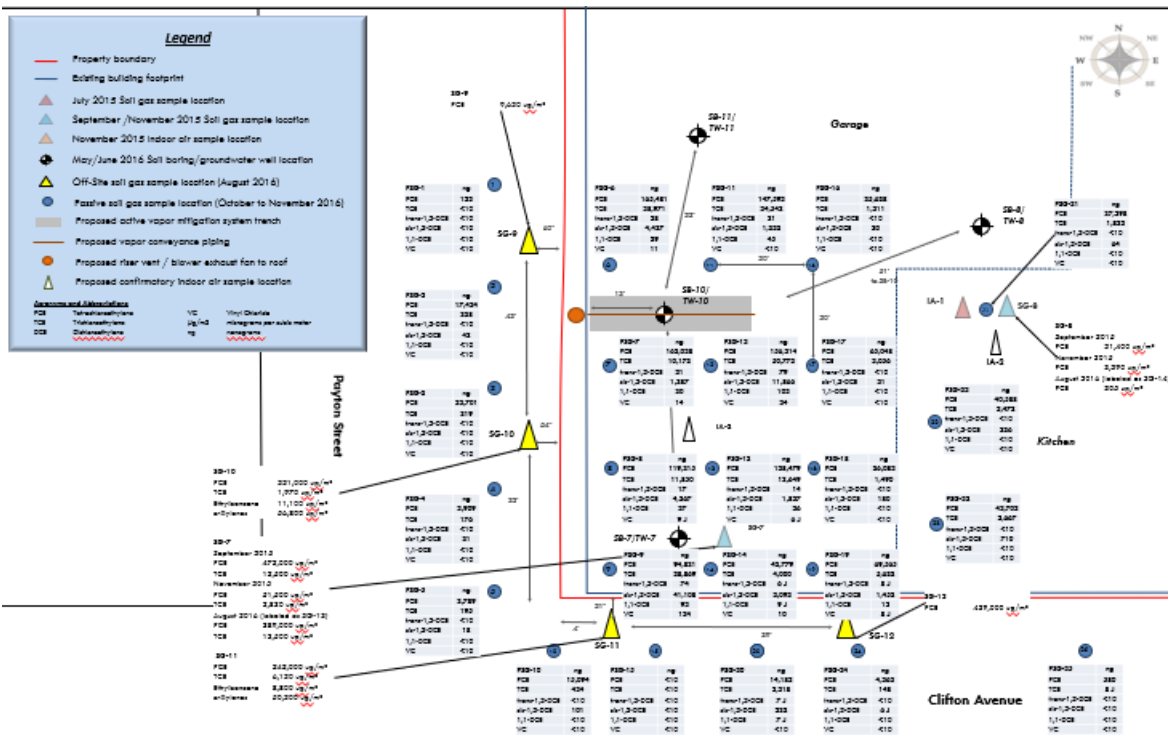
Initial Actions

- Review Prior Reports – Phase I and II ESAs
- Supplemental Phase II – Soil, Groundwater, Soil Gas Sampling

Results

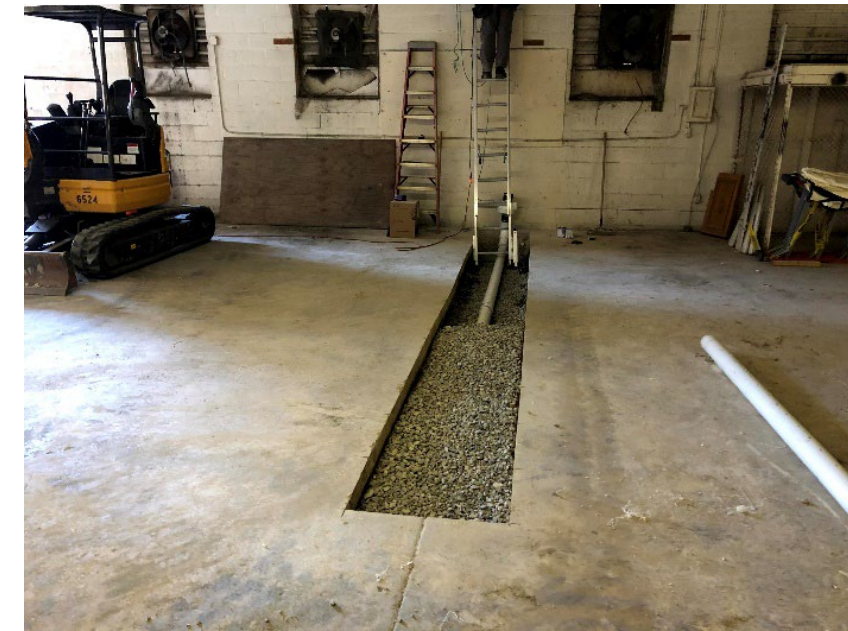
- PCE and TCE in Soil Gas
- VOCs and TPH DRO/GRO in Groundwater





SUPPLEMENTAL INVESTIGATIONS

- Extensive Supplemental Phase II ESAs (2016 to 2019) including a proposed CAP in 2018 (later revised and submitted in 2019)
- Site Soil, Groundwater, Soil Gas and Indoor Air
- Offsite Soil Gas
- Passive Soil Gas (long term) study
- Results – significant localized PCE issue in soil gas in building
- Land Use Restrictions to address impacts in groundwater and soil



SSDS DESIGN AND INSTALL

Primary System

- 15 ft x 1 ft x 2 ft trench
- 3 inch pvc piping
- FanTech RN2
- Pressure Gauge/Alarms
- Permanent VMPs
- Soil Removal

Secondary System

- Extraction Sump
- 3 inch pvc piping
- FanTech RN2
- Pressure Gauge/Alarms
- Permanent VMPs
- Waste Disposal

Confirmatory Sampling

- Effluent Sampling (monthly) – 6 mos.
- Soil Gas Sampling – 1, 6, 12, and 36 months
- Indoor Air Sampling – 1, 6, 12, and 36 months

Analyte	CAS Number	Tier 1 Target Subslab		Sample ID	1-Month Sampling Event			6-Month Sampling Event			12-Month Sampling Event			36-Month Sampling Event		
		Soil Gas Concentration	Soil Gas Concentration		Subslab	Subslab	Subslab	Subslab	Subslab	Subslab	Subslab	Subslab	Subslab	Subslab	Subslab	
		(ug/m ³) ⁽¹⁾	(ug/m ³) ⁽¹⁾		Depth	Subslab	Subslab	Subslab	Subslab	Subslab	Subslab	Subslab	Subslab	Subslab	Subslab	
Volatile Organic Compounds (TO-15 / ug/m ³)																
Acetone	67-64-1	13,700,000	68,500,000		ND (27,300)	21.5	989	ND (6,000)	ND (9.60)	ND (96.0)	ND (6,140)	28.3	ND (194)	ND (1,200)	ND (19.2)	ND (24.0)
Benzene	71-43-2	1,600	8,000		ND (1,820)	1.02 J	64.6 J	ND (400)	ND (6.64)	ND (6.40)	ND (410)	2.24 J	ND (12.9)	ND (80.0)	ND (1.28)	ND (1.60)
Carbon disulfide	75-15-0	310,000	1,550,000		ND (17,700)	6.48	ND (451)	ND (3,900)	ND (6.24)	ND (62.4)	ND (3,990)	ND (15.6)	ND (126)	ND (780)	ND (12.5)	ND (15.6)
Chloromethane	74-87-3	40,000	200,000		ND (1,160)	0.91 J	ND (29.6)	ND (256)	ND (0.41)	ND (4.10)	ND (262)	ND (1.03)	ND (8.28)	ND (51.3)	ND (0.82)	ND (1.03)
cis-1,2-Dichloroethene	156-59-2	15,400	77,000		2,700 J	ND (0.79)	951	ND (494)	ND (0.79)	1,330	913 J	ND (1.98)	487	139	ND (1.58)	189
trans-1,2-Dichloroethene	156-60-5	31,000	155,000		ND (2,470)	ND (0.79)	ND (57.1)	ND (494)	ND (0.79)	38.1	ND (506)	ND (1.98)	16 J	ND (98.8)	ND (1.58)	9.12
Ethylbenzene	100-41-4	5,000	25,000		ND (2,470)	1.22 J	ND (62.9)	ND (544)	ND (0.87)	ND (8.70)	ND (557)	ND (2.18)	ND (17.6)	ND (109)	ND (1.74)	ND (2.18)
4-Ethyltoluene	622-96-8	—	—		ND (2,780)	4.33	128 J	ND (613)	ND (0.98)	ND (9.80)	ND (627)	2.46 J	ND (19.8)	ND (123)	ND (1.96)	ND (2.45)
n-Heptane	142-82-5	176,000	880,000		ND (2,330)	1.48 J	ND (59.2)	ND (513)	ND (0.82)	ND (8.20)	ND (525)	ND (2.05)	ND (16.6)	ND (103)	ND (1.64)	ND (2.05)
Methyl ethyl ketone (2-Butanone)	78-93-3	2,200,000	11,000,000		ND (3,860)	3.66	162 J	ND (850)	ND (1.36)	ND (13.6)	ND (870)	ND (3.40)	ND (27.5)	ND (170)	ND (2.72)	ND (3.40)
Propene	115-07-1	1,320,000	6,600,000		ND (3,860)	ND (1.10)	ND	ND (850)	ND (1.36)	ND (13.6)	ND (870)	ND (3.40)	ND (27.5)	ND (170)	ND (2.72)	4.3
Styrene	100-42-5	440,000	2,200,000		ND (1,680)	0.68 J	ND (42.6)	ND (369)	ND (0.59)	ND (5.90)	ND (378)	ND (1.48)	ND (11.9)	ND (73.8)	ND (1.18)	ND (1.48)
Tetrachloroethene	127-18-4	18,000	90,000		955,000	11.1	20,500	44,800	35	5,510	264,000	1,210	6,690	72,600	626	1,060
Toluene	108-88-3	2,200,000	11,000,000		ND (2,130)	5.13	196 J	ND (875)	ND (1.40)	ND (14.0)	ND (896)	47.1	39.6 J	ND (175)	6.63	8.67
Trichloroethene	79-01-6	880	4,400		6,720 J	ND (1.10)	1,820	ND (888)	ND (1.10)	1,070	2,340 J	15	695	511	17.6	177
Trichlorofluoromethane (Freon 11)	75-69-4	310,000	1,550,000		ND (3,120)	37.5	ND (79.5)	ND (888)	1.12 J	ND (11.0)	ND (704)	426	477	ND (138)	207	248
1,2,4-Trimethylbenzene	95-63-6	26,400	132,000		ND (2,780)	6.1	213 J	ND (613)	1.18 J	ND (9.80)	ND (627)	2.95 J	ND (19.8)	ND (123)	ND (1.96)	ND (2.45)
1,3,5-Trimethylbenzene	108-67-8	26,400	132,000		ND (2,780)	1.77 J	128 J	ND (613)	ND (0.98)	ND (9.80)	ND (627)	ND (2.45)	ND (19.8)	ND (123)	ND (1.96)	ND (2.45)
2,2,4-Trimethylpentane	540-84-1	—	—		ND (2,640)	1.68 J	ND (67.2)	ND (581)	ND (0.93)	ND (9.30)	ND (595)	38.3	ND (18.8)	ND (116)	ND (1.86)	ND (2.33)
Vinyl chloride	75-01-4	2,800	14,000		ND (1,450)	ND (0.51)	155	ND (319)	ND (0.51)	106	ND (326)	ND (1.28)	134	ND (63.8)	ND (1.02)	127
o-Xylene	95-47-6	44,000	220,000		ND (2,470)	1.74 J	75.3 J	ND (544)	ND (0.87)	ND (8.70)	ND (557)	ND (2.18)	ND (17.6)	ND (109)	ND (1.74)	ND (2.18)
m- & p-Xylenes	1330-20-7	44,000	220,000		ND (4,830)	3.82 J	138 J	ND (1,060)	1.74 J	ND (17.0)	ND (1,090)	5.65 J	ND (34.3)	ND (213)	3.82	5.65

Notes / Superscripts

Thank you!

Denise A. Sullivan, P.E.
denise@ugenv.com
phone: 410-244-7215

David Sena
david@ugenv.com
phone: 410-244-7215